[COMMITTEE PRINT]

THE GLOBAL FOOD AND POPULATION EQUATION: A FRAGILE BALANCE

REPORT

PREPARED BY THE

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT

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LETTER OF TRANSMITTAL

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
U.S. HOUSE OF REPRESENTATIVES,
Washington, DC, July 27, 1989.

Hon. ROBERT A. ROE,
Chairman, Committee on Science, Space, and Technology,
House of Representatives, Washington, DC.

DEAR MR. CHAIRMAN: Enclosed is the report, "The Global Food and Population Equation: A Fragile Balance," approved by the Subcommittee on Natural Resources, Agriculture Research, and Environment.

In February, 1989, the Subcommittee on Natural Resources, Agriculture Research, and Environment held three days of hearings on the prospects for future food production to meet the food needs of a growing global population. The witnesses, who included some of the world's leading experts on agricultural technology and economic development, explored the fragile relationship of population growth, food production, environmental degradation, economic development and the management of natural resources.

While some witnesses professed optimism that the world can meet future food needs, all agreed that the challenge is an extremely difficult and important one, whose successful resolution depends both upon declines in population growth as well as increases in food production.

The experts also agreed that the natural resource base upon which further agricultural productivity depends is itself in jeopardy, threatened by environmental degradation fueled by rapid population growth and the use of unsustainable agricultural technologies.

The Subcommittee staff prepared a draft report analyzing those hearings and summarizing the findings and recommendations of the witnesses. The staff was assisted with this task by Ms. Susan Fletcher of the Congressional Research Service, whose contribution is gratefully acknowledged.

On July 26, 1989, a quorum being present, the Subcommittee on Natural Resources, Agriculture Research, and Environment met, and having considered the report, approved it and forwarded to the full Committee with a recommendation that it be issued as a Committee report.

Mr. Chairman, the report is not a comprehensive analysis of the global food problem. In particular, international debt, unsound government policies, and political turmoil all have profound effects on agricultural production and food distribution which must be addressed.

But the Subcommittee believes that the report will contribute to a better understanding of the critical role of sustainable agricultural development and population policy in meeting the world's future food needs. It is our hope that the report will be used by other Committees with jurisdiction over our foreign assistance programs and the multilateral development banks.

It is also our hope that this report will prove to be useful to delegates to the historic Centenary Conference of the International Parliamentary Union, to be held in London in September, where representatives of parliaments from all of the world will take up this important topic of the relationship between population and food.

We request that the report be presented to the full Committee for consideration at the earliest convenient time.

Sincerely,

JAMES H. SCHEUER,
Chairman, Subcommittee on Natural Resources, Agriculture Research, and Environment.

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THE GLOBAL FOOD AND POPULATION EQUATION: A FRAGILE BAIANCE

I. EXECUTIVE SUMMARY

The difficulties of maintaining a balance between food supply and the demands of a burgeoning population have long been noted. The writings of great Western thinkers, such as Benjamin Franklin, Adam Smith and Thomas Malthus, observed the tenuous balance which existed between agricultural production and unrestrained population growth in the late 18th century.

Since then, the developed nations have undergone a series of technological revolutions in agricultural production, transportation and health care. Agronomists have developed plant strains that have vastly improved the yield and nutritional value of crop plants. Advances in transport and agricultural technologies, including wide-scale irrigation and intensive use of chemical fertilizers and pesticides, have made it possible for certain areas of the world to be regarded as "bread baskets" capable of producing a tremendous abundance of raw agricultural products to be channeled through a global distribution system. Scientific breakthroughs in health care have made preventable many of the infectious diseases which formerly decimated entire populations, and have made available safe and reliable methods for controlling human fertility.

The magnitude of improvements made in these areas could not have been foreseen by the 18th-century writers making the first observations about the fragile balance between food supply and population growth. Similarly, our generation's vision of the future must necessarily be limited. By definition, we cannot foresee the unanticipated technological breakthroughs that may affect the balance between the world's population and its food supply. While modeling and projections are necessarily speculative, we must look ahead, however imperfectly, to anticipate and to plan.

In early 1989, in anticipation of the historic Centenary convention of the International Parliamentary Union, the House Science, Space, and Technology Subcommittee on Natural Resources, Agriculture Research, and Environment of the United States House of Representatives held a series of hearings which examined the fragile balance between population growth, food production, and environmental degradation. The Subcommittee heard testimony from leading international experts and parliamentarians on food production, population growth, and economic development.

Although some experts professed optimism that the world can meet future food needs, all agreed that the challenge is an

extremely difficult one, whose successful resolution depends upon declines in population growth as well as increases in food production. There was further agreement that the natural resource base upon which further agricultural productivity depends is in jeopardy, threatened by environmental degradation caused in some cases by population growth and the use of inappropriate agricultural methods.

Population trends. Each year, the world adds some 90 million people to the number that must be fed. It now takes only about 10 to 11 years to add another billion to the earth's population. Most of this growth, however, is not in the affluent, developed countries, but in the developing nations of the third world. At present rates, the population of some of the poorest of the world's countries will double in the next two or three decades. This rate of growth, coupled with poverty in the fastest growing countries, puts enormous strains on human resources and makes it extremely difficult for those nations to make the investments needed for development.

Food deficits. Due to the "green revolution" and other technological developments in agriculture, in recent years the growth in world food production has on average kept sufficient pace with population growth to provide enough food to feed the world's population. But such averages belie the wide variance in nutritional health throughout the world's regions. The developed nations of the world generally enjoy food surplus. In some areas of the developing world, including India and other areas of Southeast Asia, food production has in recent years generally kept pace with population growth. But other areas, particularly Africa, face chronic food deficits. More than ten years ago, a number of African nations were net food exporters; today, per capita food production is falling despite increases both in total land under cultivation and agricultural productivity. Indeed, Africans now have twenty percent less food per capita than in 1965. While economic policies and political instability have played an important role in limiting agricultural production, particularly in Africa, the fundamental underlying problem for such regions is that the rise in population growth outstrips the rise of food production.

These regional imbalances between food production and population growth pose global distribution problems of getting the food from chronic food-surplus nations to chronic food-deficit nations. Most of the problem in food distribution is an economic one: poor countries do not have the income needed to buy food from food-surplus countries. The problem is compounded by the international debt situation. These distribution problems, linked to the larger issue of global inequality of wealth and resources, are not likely to be solved in the near future. Food-surplus countries can provide food aid to meet the most dire emergencies, but food aid is not a viable, long-term answer to redress the global food imbalance.

The future of food production. While future agricultural technologies and improved economic policies will add modestly to future food productivity, most experts believe that the large leaps in food production experienced in the 'green revolution' will not be duplicated. Most arable land, expecially in rapidly growing countries, is already under production. Other potentially arable land is being lost to the pressures of rapidly-growing urban areas in the developing world. New technologies, including biotechnology and mariculture, are not likely to increase food production yields sufficiently to keep pace with present high rates of population growth in food-deficit nations.

Environmental constraints to increased food production. Increasingly, experts have come to recognize the environmental constraints on increased food production. While capacity for increased utilization of land resources exists in food-surplus countries, environmental constraints may begin to reduce this capacity. Modern agricultural technologies, dependent in large measure on the use of fertilizers, herbicides, pesticides, and extensive irrigation, have contaminated ground water supplies. In other areas, ground water has been pumped to such an extent that the water resources have been critically reduced, threatening the future viability of ground water - dependent irrigation schemes. Indeed, water scarcity is likely to become a severe constraint to agricultural production in many areas.

In both the developed and developing world, fragile, marginal lands have been cleared for farmland to meet the growing demand for food, resulting in the loss of valuable topsoil and contributing to tremendous flooding and devastation. When soil erosion reaches advanced stages, the result is desertification and ultimately the loss of this land from agricultural production. Such "unsustainable" practices destroy the underlying resource base needed to grow food, further escalating the cycle of imbalance between food demand and food supply.

Global environmental issues may also impact on future agricultural productivity. Increases in atmospheric concentrations of carbon dioxide and other trace gases have been linked by scientists to a "greenhouse effect" which could have serious implications for world agricultural production. While regional impacts of such a global warming cannot presently be reliably predicted, many models suggest that regional impacts on temperature and precipitation could be severe, particularly in those areas of the world -- such as the American mid-west and California -- that have historically been viewed as the world's "bread basket." The drought and heat wave that afflicted the American mid-west in 1988 was a dramatic illustration of the possible impacts of future global warming, as massive grain reserves were drawn down to the lowest level in many years. Were the drought to be sustained, it is unlikely that American farmers could export sufficient grain to meet worldwide grain demand.

Ironically, agricultural practices themselves may be contributing to the greenhouse effect. The burning of savannahs and rain forests to clear the land for planting contributes significantly to atmospheric carbon dioxide, while increased cultivation of rice and livestock are suspected sources of increased atmospheric methane, which also contributes to a greenhouse effect.

Conclusions and Recommendations

The spectre of a world in which some nations diet while others starve remains an urgent, haunting image. But it is likely to persist, and without global attention, to get worse.

The food to feed the world's expected billions can come from two places: the developed or the developing nations. While the developed nations have the capacity to increase food production, most experts believe that rate of growth in food productivity achieved by those nations in the last few decades will not be sustained. Environmental side effects of high technology agriculture and the lack of new "breakthrough" technologies suggest that the developed nations may be close to the limit of achievement in food productivity. Further, the long-term future productivity of these regions is threatened by climate change. But even if the developed countries could achieve higher levels of food production, it would not solve the fundamental problem of food distribution. Without a fundamental change in the world economy, the poorer, food-deficit nations will continue to witness starvation and malnutrition on a massive scale, even as the wealthier developed nations produce more food.

The goal rather should be to reduce the regional imbalances between food production and food demand. To put it in other terms, the developing nations must strive to achieve food security, either by growing enough food to feed their own people or by generating sufficient reliable income to buy food.

In turn, the regional imbalances between food supply and demand can be addressed in two ways: by increasing supply or reducing demand. Most experts believe that modest increases in food production are possible in the developed world. Adoption of appropriate economic policies and sustainable agricultural technologies appropriate for the social, economic, and ecological conditions of the country can increase food production.

But most experts also agree that increasing food production modestly will not close the gap with the growing food demand caused by high rates of population growth in some regions. The lack of arable land, the marginal and fragile nature of soils in many regions, and the lack of any new technologies which are likely to increase yields significantly, will ultimately limit food production.

If the regional imbalances are to be addressed, it is clear

that the unprecedented rates of population growth being experienced in many developing nations must be brought under control through the adoption of policies and programs encouraging family planning. Even if food production growth rate were to double from an average of 1 to 2 percent per year, a highly unlikely prospect, food deficits would still occur in nations experiencing population growth rates higher than 3 percent.

In addition to reducing demand directly, reducing population growth rates will have other beneficial effects which also help to increase food production. In this regard, the role of women in family planning, and agricultural and environmental activities is critical to acknowledge. Women in developing countries carry out 60 to 90 percent of agricultural production. However, their role has been too frequently overlooked in assistance programs, to the detriment of economic development.

To reduce the economic and political instability that will inevitably accompany a world divided into haves and have-nots, the developed nations must assist the developing world to reduce the regional imbalances between food supply and demand through expanded programs of technical assistance which emphasize appropriate agricultural development and family planning programs.

II. HEARINGS

The Subcommittee on Natural Resources, Agriculture Research and Environment held three days of hearings in early 1989 to examine the interrelationship between food production and distribution, the deteriorating global environment and the demands of a steadily increasing population. Testimony was provided by agricultural scientists, economists, environmentalists, and world leaders. (A complete list of witnesses is attached as an Appendix to the Report.)

In this series of hearings, the Members of the Subcommittee focused on an overview of the global food-population situation. Particular emphasis was given to technologies to improve agricultural production in a manner which is environmentally sound and sustainable, and an analysis of international strategies to accomplish this goal. Leading experts on population, agriculture and environment addressed the critical policy questions related to the question of whether the world can feed its burgeoning population, and what measures are needed to avoid global catastrophe as population growth exerts pressure on the environment, the resource base, and on human societies.

The first hearing, on February 23, 1989, assessed technological approaches to solving the crisis in food production. Witnesses provided testimony on the current status of grain reserves throughout the world and future forecasts for meeting the demands

of an ever increasing population. Sustainable agricultural practices especially as they apply to fragile, marginal lands were also discussed. Witnesses debated whether a resurgence in agricultural productivity similar to that brought about by the techniques of the "green revolution" could be counted on to meet the nutritional needs of an expanding population. Several newly emerging technologies, biotechnology and mariculture, were examined in considerable detail since they hold the strongest promise for increasing food production.

The second hearing, on February 28, 1989, examined the environmental constraints on food production and the social and political implications of the imbalance in the global distribution of food and population. The panel also addressed global economic, environmental, and developmental policy responses needed to alleviate this potentially destabilizing situation.

On the third day of hearings, on March 2, 1989, members of Parliaments from developed and less developed countries provided an appraisal of the political and demographic consequences of rapid population growth and the necessity of a strong family planning infrastructure as a prerequisite to improving the quality of life. Testimony was also provided by international scholars.

The complete record of the hearings is published in Committee Print 101-3, "Overview of the Global Food and Population Situation."[1]

This report reviews the testimony of the hearings, identifying the major issues brought up by witnesses, and the policy options that were suggested. Although many experts profess optimism that the world can meet future food needs, all agreed that the challenge is an extremely difficult one, whose successful resolution depends upon declines in population growth as well as increases in food production. There was further agreement that greater attention to protection of natural resources and avoiding environmental degradation was essential.

The first three sections below review testimony on (1) the population growth context; (2) food production, including adequacy of the current system for food production and distribution as well as the promise of future technological developments; and (3) environmental constraints and issues, including sources of stress on the natural resources needed for

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[1]"Overview of the Global Food and Population Situation" before the Subcommittee on Natural Resources, Agriculture Research and Environment, of the Committee on Science, Space, and Technology, U.S. House of Representatives, 101th Cong. 1st Sess., [hereinafter cited as "Hearing"].

current and future food production and environmental problems related to population growth and unsustainable production methods. The final section examines the issues facing global leaders as they formulate policies aimed at protecting human health and the environment and contains recommendations made by the witnesses.

III. POPULATION GROWTH: THE CONTEXT OF DEMAND

Population growth during the 20th century has profoundly changed the context of all human endeavors and economic development. At the beginning of this century, worldwide population was well under 2 billion; by the year 2000, it will be close to or perhaps over 6 billion. The 5.2 billion people now inhabiting the earth already strain available resources, and the rapid growth in numbers will continue for decades, with estimates for a levelling off at 10.5 to 14 billion in the 21st century.[2]

The world's population growth rate reached its highest point in the 1960's at approximately 2 percent per year. Today the growth rate is about 1.7 percent per year, adding some 85 to 90 million people to the world each year; in 1980, 8 countries had more than 90 million people. A growth rate of 1.7 percent is the highest level ever confronted by most of the developed countries as they built their economies.[3]

This decline in the growth rate masks enormous disparities among regions and nations, some of which are dealing with historically unprecedented growth rates of 3.5 to 4.0 percent per year. Doubling times in these countries are between 15 to 20 years. With more than half the population under age 15 in some of these countries, a heavy burden is placed on infrastructure, resources, and social services. According to James Grant, Executive Director of the United Nations Childrens' Fund (UNICEF), the "physical quality of life index (PQI)", as defined by per capita income, food consumption, housing, literacy and other standards, is declining.[4] Many of today's poorest countries face the prospect of twice as many people to support within the next 20 to 40 years.

The time it takes to add a billion people to the earth's population has been rapidly shrinking. Subcommittee Chairman James H. Scheuer pointed out:

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[2]"World Population in Transition" by Thomas W. Merrick. In Population Bulletin, vol. 41(2). [January 1988 reprint.] Published by Population Reference Bureau, Inc.

[3]Ibid.

[4]Letter to the Chairman.

> It took us a million years to achieve a billion population; we achieved that in 1830. It took us another hundred years to achieve the second billion in 1930, and then ...about 30 years to achieve the third billion in 1960, and then it was 17 years for the fourth billion, and 12 years for the fifth billion, and that's where we are now.[5]

The global population is expected to reach 6 billion by the end of this century. Approximately 90 percent of the anticipated increase will be in the developing countries, often in areas already facing deficits or near-deficits in food production. In most of these countries, as discussed in the next section, all or nearly all of the land available for agriculture is currently in production and thus expansion into unused areas is rarely an option for increasing food production.

In some nations, rapidly increasing population has led to extreme densities of population. Robert Chandler, 1988 winner of the World Food Prize, and a pioneer in the "green revolution" that increased food production dramatically in Asia during the 1960's and 1970's, cited Bangladesh as an example of "overpopulation". That country, which had 87.5 million people in 1980, now has 113 million concentrated in 55,000 square miles; this amounts to 2,028 people per square mile, compared to 985 per square mile in the state of New Jersey in the United States, or 900 per square mile in Japan.

In discussing the potential for increased food production, Dr. Chandler linked well-being directly to population size.

> To me, the high population growth rate is the most serious threat to the well-being of mankind. With a finite world and an infinite population [growth], they just don't go together. We're going to commit suicide one way or another unless we can control our population in the long run.[6]

Maurice Strong, first Secretary General of the United Nations Environment Programme (UNEP) and long recognized as a world leader in environment and development, also closely linked food problems with population growth:

> Surpluses in industrial countries and deficits in developing countries continue, despite the fact that in developing countries, food production in the 1970's and '80's grew more than twice as fast as in the developed countries. The problem... is population growth in the developing world, so that

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[5]Hearing at p. 36.

[6]Hearing at p. 19-20.

> even those countries which did experience growth in their own food production had that growth largely and in some cases fully offset by population growth. So you cannot view the food issue in any other way than in its relationship to population growth and to the growing nutritional and food needs in existing populations.[7]

Lester Brown, President of the Worldwatch Institute, noted that as malnutrition associated with decreasing food consumption takes its toll, infant mortality will increase. Although there is relatively little data, in Madagascar for example:

> [T]heir per capita consumption... is now clearly contributing to an increase in malnutrition and hunger. Food production is falling. They don't have the foreign [currency] exchange to import. So it is belt tightening among people who don't have any notches left. The infant mortality rate has gone from something like 105 [per thousand] to 130 over the last several years, with nothing in prospect to reverse that rise. Unfortunately, we are now beginning to see increases in infant mortality rates in countries like Ghana, Brazil, Peru, many of the countries in Africa.[8]

The implications of such a rapid increase in absolute numbers were pointed out by the Honorable Celso Sotomarino of Peru, who recounted the experience in some Latin American countries. He pointed out that the population of Lima, Peru, was 500,000 in 1940; today it has increased to 7 million.[9] Congressman Scheuer told of his stay as a student in Mexico in 1939 when 18 million people lived there. Fifty years later, the figure is 75 million.[10] The urbanization associated with such growth places a huge burden on a country's infrastructure, and contributes to a low level of human resource development.

The magnitude of social and economic adjustment for such quantum leaps in growth is enormous, and in many cases, adjustment has been downward, to a lower standard of living for the majority of the population.

In contrast, population growth rates in developed countries have decreased, sometimes to near replacement levels. The

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[7]Hearing at p. 318.

[8]Hearing at p. 221.

[9]Hearing at p. 399.

[10]Ibid.

process is known as the "demographic transition". As high death rates are brought to lower levels by better health and medical care, birth rates initially remain high, and population growth increases rapidly. This first stage of the demographic transition is succeeded by a second stage in which birth rates also fall because increased prosperity and lower infant mortality provide social incentives for smaller sized families. This transition is also associated with improvements in the social and economic condition of women. Increased education and employment opportunities, combined with access to family planning services, reduces the incentives for child bearing. As birth rates are reduced, balance is restored between deaths and births and the "demographic transition" is completed. The important factors that appear to provide motivation for smaller families are widespread literacy, increased education levels, wider employment options and higher social status for women, and higher family incomes.

Dr. Fred Sai, Senior Population Adviser to the World Bank, and former Minister of Health in Ghana, expressed the concern that if a society cannot achieve the the social and economic development that correlates with lowered birth rates, then a high population growth could inhibit development.

> I am referring particularly to the theory today which maintains that population is neutral in the development equation; that given [a higher] level of development, the population will come down by itself.
>
> I think what is more likely to be the true situation is that population has a two-way relationship with development; ...that there are levels of population growth rate, there are ways of population settlement which could be inimical to the development process itself. [11]

The World Resources Report 1988-89 notes that the momentum of growth in developing countries, even after birth rates fall, is likely to continue.[12] In these populations, there are very large numbers of people in the younger age groups, and in many developing countries today, nearly half the population is currently below age 15. This means that even if the individuals in these populations began to have smaller families, there would be so many people in their reproductive years over the next several decades, that very large numbers would continue to be

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[11] Hearing at p. 449.

[12] World Resources Institute. World Resources 1988-89: An Assessment of the Resource Base that Supports the Global Economy. Basic Books, Inc., New York, New York. 1988. [hereinafter cited as "WRI Report"]

added each year to the population.

Although hopes for slower population growth hinges on the decisions of these individuals, they are coming of age in poorer societies which cannot provide the education and incomes that will engender smaller sized families. While there is agreement that improvements in the status of women in these societies will be critical to smaller family size, such changes are not yet evident in most developing countries, particularly Africa.

An important factor contributing to lower fertility rates, especially in developing countries, is strong government policies to promote effective and readily available family planning:

> Increasing numbers of people increase demands on natural resources. Clearly, more people require more food, fuel, clothing, and the other necessities of life....Can the world's natural resources support the growing world population, or will human demands overwhelm the capacity of natural systems? Can the earth's finite resources of soil, water, and its biological processes continue to meet the demands of 5 to 10 billion people without collapsing and bringing on the Malthusian specter of increasing poverty and starvation?
>
> Over 90 percent of the projected addition of roughly 3 billion people living in the year 2025 will live in what are now low-income African, Asian, and Latin American countries. Many of these countries already face agricultural land shortages, limited water supplies, depleted forest resources, and/or degraded soils. Without rapid economic development, can these countries meet the needs of almost twice as many people within the next 40 years?[13]

In confronting the question of how to reduce population growth rates, the testimony at the hearings covered the full range of development needs in poverty-stricken countries. Only when the many economic and social development factors associated with lowered population growth, i.e., the demographic transition, are present is family planning likely to be more widely used.

The Honorable Robert Key of England stated:

> Your family planning associations are not just about birth control; they can reach parts of the economy where nobody else can reach. And I have seen for myself the work of family planning associations ... where they are involved in

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[13]WRI Report at p. 17

> sophisticated problems like parasite control, or in other parts of the world they're involved in literacy campaigns....[and] banking....they have actually shown the local communities that it is they, the individual mothers and fathers in the villages who do have it in their power to change the future.[14]

Dr. Carl Wahren, Director of the Aid Management Division of the Organization for Economic Cooperation and Development, stated:

> The countries which have been most successful in lowering national birth rates have many features in common. They have given high priority to the development of human resources. They have invested in social services, including health and education, paying special attention to the status of women, female employment and improving maternal and child health care. They have given strong support to family planning information as well as to contraceptive services. Many of these countries have explicitly tried to provide for growth with equity.[15]

A. The Role of Women

The pivotal importance of the role of women in the social dynamics governing population growth, in the agricultural systems of developing countries, and in protection of natural resources was a recurrent theme among the witnesses' testimony. According to Dr. Fred Sai, of the World Bank:

> Women--woman--that is the major link in this, because in much of Africa the people who produce food crops are women. They are also the people who produce the family food; but they are the people who produce the children too. ...And the quality of the human capital that is available, therefore, for looking after that environment is disproportionately women quality.
>
> And the health of women, the education of women, the way that women are taught to handle technology will be the major engine that will drive any issue that seeks to bring together population, the environment, and food--at least in Africa, and to a large extent in Asia.[16]

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[14]Hearing at p. 446.

[15]Hearing at p. 470.

Dr. Waafus Ofosu-Amaah of WorldWIDE, reporting on the African Women's Assembly on Sustainable Food Production,[17] testified that while women provide between 60 and 90 percent of the subsistence labor for agriculture and an increasing proportion of cash crop labor, their concerns have been historically ignored or neglected by policymakers. The result is that programs designed to increase agricultural efficiency are directed at men, ignoring the considerations of those directly responsible for agricultural production -- the women.

> These women felt that there was some cultural constraints on their participation in development programs. They were not consulted, and that was one of the reasons why many of the so-called 'development programs', especially foreign assistance programs, have not been successful. They were treated merely as the implementors, and their needs, their concerns, their knowledge, was often not even incorporated into any of these development planning and implementation activities.[18]

Dr. Ofosu-Amaah recounted the many constraints that prevent women from playing an effective role in development:

- -- limited access to land title, limiting women's ability to participate in the economy due to lack of capital;
- -- lack of money to buy tools needed for production;
- -- lack of access to credit which is closely linked to lack of land title;
- -- heavy workload and lack of time to develop or participate in new initiatives;
- -- lack of education, resulting in widespread illiteracy which hampers ability to take advantage of agriculture extension service and other programs to foster agricultural productivity;
- -- poor design of development projects, such as water

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[16]Hearing at p. 451.

[17]The African Women's Assembly on Sustainable Food Production, held in February 1989 in Harare, Zimbabwe, brought together women farmers and officials from 20 African countries to discuss agricultural and environmental issues of importance to women and to policymakers in their countries. The conference was held under the auspices of the United Nations Environment Programme and other governmental and non-governmental sponsors.

[18]Hearing at p. 198.

pumps too heavy for women and children to operate, despite the fact that water collected is traditionally performed by women and children;

-- lack of support in general for subsistence agriculture, in favor of economic development support for large agricultural projects directed toward cash crops.[19]

A general underlying problem identified by several witnesses, including the Honorable David J. Kwidini, Minister of Youth, Sports and Culture in Zimbabwe, was the lack of status for women in their own localities. In many areas, even when women wish to control their own fertility, their husbands may object. Minister Kwidini stated:

> The problem [of fertility control] lies with men, and this is being recognized more and more in many African countries. And because of that recognition, family planning services are no longer only for women, they are also for men in order to educate them to the needs of those services.[20]

The Honorable Sat Pau Mittal of India pointed out that in the Indian state of Kerala, where family planning has had the greatest success, there is a high level of literacy and respect for the role of women.

> The recent studies on this situation have revealed that Kerala is far ahead [in family planning success] of some of the states in the North, primarily because the percentage of female education is much higher in Kerala than in other states. The studies reveal that 60 percent of the females, even in the rural areas, are educated.[21]

IV. FOOD PRODUCTION: WHERE WILL THE NEEDED FOOD COME FROM?

The growth in human numbers creates ever-growing demands upon the food production systems of the world. As Patricia Baldi, Population Director of the National Audubon Society, noted:

> The... United Nations study on agriculture found that by the year 2000, with a global population of 6 billion, the world agricultural output must be 50 to 60 percent greater than in 1980. Because of

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[19]Hearing at p. 199.

[20]Hearing at p. 446.

[21]Hearing at p. 346.

> population growth in developing countries, the demand for food and agricultural products will double.[22]

A number of critical questions were raised concerning the potential of food production systems to meet needs of existing populations and the growing numbers of people being added every day. This discussion is summarized below under (1) the potential of the current system to meet the needs of current and future populations, including food production capability, food distribution problems, and food aid; and (2) future options and technologies, including marine food production -- mariculture, biotechnology, and increased production on marginal lands.

A. Potential of the current system to meet the needs of the world's people

The task of feeding the existing world population has proven difficult within the current agricultural production and distribution system. Testimony at the Subcommittee's hearings included varied opinions on the capacity to meet current and future needs.

1. Food production capability

According to the testimony of some witnesses, the world food situation is not currently at a crisis stage, and future food production could fulfill human needs if population growth slows down. Other testimony, however, predicted a slowing down in the rate of agricultural yield in the face of continued high population growth.

The current food situation reflects recent weather difficulties that have severely reduced stocks of food around the world. According to the United Nations Food and Agricultural Organization (FAO), global cereal supplies will remain tight in 1989 and 1990, particularly for wheat and rice. Currently, stocks are at their lowest levels in a number of years; even if weather is ideal for the rest of 1989, world cereal output would not be sufficient to replenish stocks to the minimum levels required for global food security.

Food aid availability is expected to be lower in 1989 and 1990 as a result of reduced crops in major exporting countries. Reduced food aid could be critical for many food deficit countries.[23] World cereal consumption in 1989 is down by some 7 million tons from last year's levels. This reduction in consumption results in part from less beef consumption in

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[22]Hearing at p 187.

[23]Food Outlook, FAO, March 1989.

developed countries, and therefore less grain used as animal feed.

Dr. Ronald Trostle, Chief of the Commodity and Trade Analysis Branch of the U.S. Department of Agriculture, stated that in terms of production -- leaving aside distribution questions -- the world is producing enough food to feed current populations and will be able to cope with some additional increases.[24]

Dr. Trostle recalled that world food output has risen about 2.5 percent per year with productivity alone, exclusive of increases in land used at 1.9 percent. If this rate of increase for productivity could be maintained over the next several decades, Dr. Trostle stated that world average per capita food production could still be maintained, assuming continued decreases in population growth rates.

> Now if world population growth rates do not decline as rapidly as they are projected by a number of demographers, or if world productivity growth slows down more quickly than expected, then world food production may begin to lag behind population growth, and shortages may occur.[25]

Even in that case, Dr. Trostle saw room for adjustment. Shortages of food would simply cause readjustment in the composition of people's diets, with people resorting to "more basic foods."

> The price of meat, for example, would rise much more than the price of cereals and the basic foods, causing more grain to be consumed directly rather than fed to animals to produce meat. The grain currently fed to livestock in the United States, Western Europe and Canada would feed nearly one billion additional people if consumed directly rather than as meat.[26]

Dr. Trostle indicated that since the mid-1980's, total world food production has shown little growth. He attributed the slowdown in growth to a number of temporary factors:

-- large world stocks from abundant harvests;
-- low prices of many agricultural commodities which discouraged production;
-- a reduction in growth of the global crop area, caused in

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[24]Hearing at p. 99.

[25]Hearing at p. 99.

[26]Hearing at p. 100.

> part because of a U.S. acreage set-aside program intended to discourage production of surplus crops that were bringing down agricultural prices.[27]

However, Dr. Trostle also discussed a number of long term constraints on future agricultural productivity including land and technology:

> Land is being more intensively used in most of the world, and this is causing some environmental problems... In the future, irrigation will play a reduced role in productivity growth, and in the future also I think we can see fertilizer and energy prices increase, which will increase the cost of production for most producers in the world. Technology will play a more important role in future gains in agricultural output because of the constraints on increasing planted area; however, there is some concern about the ability [of technology] to sustain increases in productivity.
>
> The growth in crop yields has recently shown minor signs of slowing down. The 'green revolution' technologies have already been widely distributed; a gap between economically feasible yields in experiment stations, such as the International Rice Research Institute, and the actual yields on farmers' fields appear to be declining. This, I think, is a suggestion that the application of existing technology around the world is catching up with the development of new technology.[28]

While it might be technically possible to feed a population of 10 billion with greatly increased investment and some sacrifice, Dr. Chandler noted:

> ... [W]e would have to give up a lot and we would have to put in a tremendous amount of investment. It's going to take a huge, enormous amount of funds, both international and national funds, to make that possible and still have this as a suitable place to live.[29]

Charles Benbrook, Executive Director of the Board on Agriculture, National Research Council, expressed confidence that food production in the near term will be sufficient to meet

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[27]Hearing at p. 98.

[28]Hearing at p. 98 - 99.

[29]Hearing at p. 51.

global food demand:

> It is my judgment that the world has the capacity, the resources and the technology to substantially increase food production in the near term and produce enough calories, if you will, to substantially alleviate much of the chronic malnutrition that exists around the world.[30]

Dr. Benbrook testified that the underutilized production base of the United States, including land now in acreage set-asides, is an essential ingredient in creating a near-term capacity to increase production.

> We, until 1989, have been holding about 30 percent of our productive land base out of production in this country for much of the 1980's [due to chronic surpluses and depressed prices]....As a result, we have basically a tremendous amount of underutilized infrastructure that could be put to the task of producing food if there was a market for it.[31]

He added a caveat of considerable importance in view of the environmental problems discussed below:

> Obviously, the capacity of this country to increase production on a sustainable basis is subject to the degree to which farmers adhere to the sound conservation principles and deal with this country's at times, and in some areas, very serious environmental problems.[32]

In addition, Dr. Benbrook noted serious "mismatches" between the food surplus capacity in many developed countries and the food shortages in developing, food deficit countries, and the accompanying difficulties in food distribution. In those areas, getting food production to keep pace with or get ahead of population growth is a key problem. He indicated:

> There certainly is not ... much unused productive capacity in food deficit regions of the world. It is not there. So there is a mismatch between where the food is needed and where it could be produced... [To] imagine a scenario of the technology and the knowledge and the production capability to emerge in the developing world fast enough to get ahead of population, I just don't

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[30]Hearing at p. 298.

[31]Hearing at p. 306.

[32]Hearing at p. 306.

see how it is going to happen.[33]

Lester Brown, of the Worldwatch Institute, expressed reservations about the continuing ability of the United States to provide surpluses if drought conditions continue to prevail in North America. He stated that environmental problems such as climate warming could create problems for countries which traditionally have food surpluses. He noted that for the first time ever last year, the United States produced less grain than it consumed and the worldwide grain reserves have been drawn down substantially.

> Against this overall loss of momentum, we had the Indian monsoon failure in 1987, and we had the drought in 1988, the North American drought. The net effect of this has been to reduce world grain reserves from the record level of 101 days equivalent of world consumption at the beginning of 1987 to less than 60 days at present. When you get down below 60 days, you don't have much more than pipeline supplies, and we have seen the effect on prices. World grain prices today are up by roughly half of what they were in, say, early last year.
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> ...Last year ... [the U.S.] did not produce enough grain to satisfy our own needs. We produced 196 million tons of grain; we are consuming 206 million tons. So we actually have a small grain deficit. Now, that's not been a major problem for us, because we have simply taken those 10 million tons out of reserves. At the same time, we annually export roughly 100 million tons of grain. And we are satisfying those export demands entirely by drawing down our stocks. In effect, we are exporting our reserves.
>
> Now as the 1989 harvests begin, reserves are at a very low level, and if we have another drought in the United States this year like last year, we will find ourselves with very little grain to export. For the first time since North America emerged as the world's breadbasket a half century ago, there wouldn't be any grain to supply the 100 or so countries that regularly import grain from us.[34]

2. Distribution system problems

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[33]Hearing at p. 306.

[34]Hearing at p. 219 - 220.

A widely discussed issue is that of world food production versus distribution. Unequal distribution of food around the world is considered by most food aid experts as the most significant obstacle to feeding the current world population.

> Despite enormous advances in agricultural science and farm production, want continues in the midst of plenty. Poverty stricken people are unable to buy enough food for good health even though crops might be abundant. Natural disasters occur: drought, flood, earthquake, and diseases of plants and animals. Wars break out, destroying food and making hungry refugees of millions. Economic depression occurs with resulting unemployment and inability to buy adequate food, however plentiful. Some people, short-changed at birth and burdened with physical or mental disability, are unable to cope by themselves even in a prosperous economy. Most people are able to meet most of their food needs most of the time. It is by no means true that all people can meet all their food needs all the time.
>
> Agricultural scientists naturally focus on food production, which, while enormously important, is only part of the problem. The other part is distribution. Many people in production agriculture take distribution for granted. Many who are interested in food aid take production for granted, which is at least as great an error.[35]

The major obstacle to food distribution rests in the global inequality of wealth. Many chronic food-deficit nations simply have too little income to purchase food from food-surplus nations at market rates. As Dr. Chandler noted,

> [T]here is sufficient food in the world to maintain the population at present standards of nutrition, which are inadequate. There are over 500 million people suffering from malnutrition in the world today, but they could be improved somewhat if all of the food that is being grown or could be grown in the developed countries like Europe, Canada, the U.S., Australia, and so forth could be distributed. ... [The problem is that] it costs money. It seems to me that national poverty and individual poverty are the big things that prevent it from getting to the country, and then you have distribution problems within the country. (Emphasis added)[36]

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[35] Toward a Well-fed World. Don Paarlburg. Iowa State University Press, 1988, p. 165.

In addition to lack of income, many food-deficit developing nations face other significant political and economic problems in distributing food. Problems identified by Dr. Benbrook, for example, included lack of roads and infrastructure, political corruption, and the use of food aid as a weapon in ideological or economic struggles.[37]

Congressman Robert Walker raised the issue of political and economic obstacles within food receiving countries as a major problem in distribution, noting that a number of governments had actually "promoted starvation as a political weapon."[38] Mr. Walker expressed concern that technology and science were unlikely to solve food distribution problems unless such political and economic issues were first addressed. Dr. Chandler responded,

> It's true there are political problems to solve, and they have to come first, no question about it. But at the same time, there are potentials for technology to play its role, too, and it's going to come.[39]

This point is underscored by the need for concentration on a range of government policies that would address not only food

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[36]Hearing at p. 51.

[37]Hearing at p. 302; see also Dr. Raymond Hopkins, Hearings, at 310-311 (Ethiopia's policy of starvation as a military weapon.)

It has been well established that the agricultural policies adopted in the past by some developing countries have adversely affected agricultural production. In particular, state policies of keeping food prices artificially low to prevent protests by urban populations pushed farmers out of production as farming became unprofitable. See, e.g., Dr. Pedro Sanchez, Hearings, at 124-125 (citing Zambia and Brazil) Dr. Ronald Trostle, Hearings, at 106 (ascribing increase in global food production in the 1970's to increases in food prices); Lester Brown, Hearings, at 255 (citing experience in Africa); "Accelerated Development in Sub-Saharan Africa: An Agenda for Action," World Bank, 1981; comments of Chairman James H. Scheuer and Rep. Robert Walker, Hearings, at 51-52 (citing Zimbabwe, Sudan and Ethiopia). Previous hearings before the Subcommittee have noted the need for market-oriented economic policies as a necessary part of any program to restore Africa's capacity to feed its population. See, generally, "Prospects for Sustainable Development in Sub-Saharan Africa", a Report by the Committee on Science and Technology, 99th Cong., 2d Sess. (H. Rept. 99-1009) at 1, note 1. As Dr. Sanchez noted, "[Price reform] is a necessary, but not sufficient, condition, and again policy and technology have to go

(Footnote continued)

production, but also food distribution within countries:

> Getting additional food into the diets of those who need it most involves much more than increasing production, difficult as that objective is. Greater production is essential, but it does not assure that the increased availability will reach the large number of hungry and malnourished people.
>
> [I]f the number of malnourished people in the world and the severity of their malnutrition is to be reduced -- rather than to be increased -- in the coming decade, there is critical need to take the steps required for rapid economic growth in low-income regions with a growing distribution of income and benefits to the poor majority of people. Only through stepped-up, worldwide effort are the poor likely to gain jobs and income they need to be able to purchase enough food, and governments to obtain the finances they need to carry out nutrition and other programs. In the interim, governments need to consider a range of food-policy issues which increase the production and effective distribution of low-cost staple food and ensure that it actually reaches their hungry and malnourished people.[40]

3. Food Aid Issues

The relative merits of food aid have been debated since the inception of the U.S. "P.L. 480" food aid program in the mid-1950s.[41] The controversy centers on whether food aid should

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[37](continued)
hand in hand." Hearings, at 125. While such political and economic issues must clearly be addressed in any long-term agricultural development effort, the hearings were not intended to discuss such policy issues which have been treated at length elsewhere.

[38]Hearing at p. 52.

[39]Hearing at p. 53.

[40]"The Nature of the World Food and Population Problem" by Maurice J. Williams. In Future Dimensions of World Food and Population, edited by Richard G. Woods. Westview Press, Boulder, Colorado. 1981. p. 5-34.

[41]The United States food aid program, known as "P.L. 480" was established by the Agricultural Trade Development and Assistance Act of 1954, Public Law 480, 83rd Congress, and has been amended
(Footnote continued)

be provided only in times of severe food deficit, and whether or not such assistance should be conditioned on domestic food surpluses. This argument has gained currency again with the reduction of U.S. food reserves as a consequence of the 1988 drought.[42]

According to testimony presented at the hearings, food aid is critically important to the survival of food deficit countries, particularly as populations increase. Dr. Raymond Hopkins, professor of political science at Swarthmore College, testified that according to a National Academy of Sciences study, food aid would need to increase from the 10 to 12 million tons of total food aid provided today to between 20 and 54 million tons of food aid by the end of the century. The average estimate of food aid needs in the year 2000, he said, would be some 37 million tons per year.

Effects on Local Food Production. Although some observers speculated that food aid works as a disincentive for local food production, there are no empirical studies which support this view. Moreover, some countries that once relied heavily on food aid have gone on to become self-sufficient in food, while other countries, such as India and South Korea, have moved beyond the position of food recipients to become net exporters of agricultural products.

Discussion at the hearings focused on ways in which food aid could damage local agricultural production if delivery systems and conditions were improperly structured, and ways in which benefits of food aid could be maximized. Food aid could create problems, it was suggested, if it served to keep food prices artificially low, thus discouraging local farmers from producing food for the market. Dr. Chandler stated that in countries dependent upon food aid, sudden changes in policy could be very damaging, causing widespread hunger and starvation. Reductions in food aid, he argued, should be phased on a gradual basis.

> I do think as a general principle, that importing food is something which is a disincentive to food production. We should concentrate all the effort we can to get the research done in the country to show how they can produce more, and to encourage

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[41](continued)
numerous times. In 1988, the U.S. gave $95 million in emergency food aid and an additional $110.4 million for non-emergency food aid under P.L. 480.

[42]"Less Food Aid is Better," an address by Larry Minear before the Conference on Food Aid in Minneapolis, cosponsored by the Humphrey Development Institute of Public Affairs and the U.S. Agency for International Development. November 28-29, 1988.

countries to have policies to get that to farmers and have it in operation.[43]

Food for Work Programs. Witnesses also addressed the issue of whether food aid under P.L. 480 should be tied to work programs in the recipient nations, so-called "food for work programs".[44]

Proponets of food-for-work programs note the ability of recipient countries to make progress toward development while alleviating hunger. Others express concern, however, that development projects carried out only for payment will not be maintained once the food aid is discontinued. In addition, food-for-work projects can cause distortions in the recipient nations' development plans as such project-oriented food aid gives the recipients countries little flexibility and may not address the highest priority needs within a country.

There was little disagreement about the critical role United States food aid will continue to play in the future for food deficit countries, and as Dr. Hopkins testified, the main question is the conditions under which it will be provided.[45] Dr. Hopkins suggested several steps within the scope of existing law which could be taken by the United States to modify existing food aid conditions. These are:

-- Selecting food aid recipients on the basis of

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[43]Hearing at p. 124.

[44] Title II of P.L. 480 provides for both emergency and non-emergency food donations. Emergency food aid in FY 1988 is for severe hunger situations and disaster relief and is not designed for food-for-work projects. Non emergency food aid includes maternal and child health, school feeding, food-for-work, and other development-oriented uses.

Several witnesses indicated that the limitation on use of United States food aid as payment for work was particularly unfortunate in the Ethiopian famine of the mid 1980's as it missed an opportunity to encourage longer term development. However, in many other countries, according to the Food For Peace Office within the U.S. Agency for International Development (US-AID), which administers food aid, P.L. 480 can be used in food-for-work situations, and is being used that way around the world. In the case of Ethiopia, extenuating circumstances, including that government's expropriation of private U.S. firms resulted in imposition of the Hickenlooper Amendment, which prohibites the use of P.L. 480 for developmental uses.

[45]Hearing at p. 311.

need, rather than other political or economic criteria;
-- Adopting policies to protect recipient nations from food price changes that might be caused by food aid;
-- Streamlining food aid to make it a fully grant program, and one related to prospects for debt forgiveness...
-- Coordinating financing and policy with other food donor nations;
-- Emphasize projects that attack fundamental problems leading to food insecurity, including high population growth, rapid urbanization, deteriorating soil and forested land, and the waste of harvested grain.[46]

B. Future options and technologies

Given the very serious problems within the current system of food production and distribution, and the admitted limitations that exist for expanding agriculture into new lands or dramatically increasing yields from current crops, agricultural scientists are seeking technological innovations to meet increasing food demands. While expanded food production can be expected from the use of technologies such as biotechnology and mariculture ("farming" in marine and fresh water environments), and from improved cultivation of marginal lands, witnesses acknowledged the drawbacks and limitations to these technologies that render them unlikely to be the principle solutions to the food crisis.

1. Mariculture

As worldwide food demands continue to increase, one option explored in the hearings for additional food production was 'farming' of the oceans. In this form of food production, fish and other marine organisms are raised under controlled conditions. Testimony at the hearing indicated that this avenue holds considerable promise for large-scale production of high protein foods; however, the prospects for widespread use of this technique is complicated by the fact that it requires a fairly sophisticated workforce, can produce high levels of marine pollution, and must be practiced in areas that are relatively unpolluted to begin with.

Dr. Hillel Gordin, Director of the National Center for Mariculture in Elat, Israel, testified that the time has come for farming the seas:

> For ages ... the production of seafood was done

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[46]Hearing at p. 257.

> mainly by fishing. And fishing, one has to understand, is basically hunting in the water. ... Time and conditions are ripe to increase effort toward the direction of moving from fishing, hunting and gathering [in the sea] to culturing. Mankind must repeat its terrestrial farming evolution once more, this time in the marine domain.[47]

Dr. Gordin explained his view that fish culture in freshwater is unlikely to meet large-scale needs because of the scarcity of, and competing demands for, freshwater sources. Therefore, the best opportunity for raising fish and other water-based organisms would be in the oceans. He noted that aquaculture is providing an increasing proportion of the total fish used for food: 9 percent in 1975; 13.5 percent in 1983; and 15 percent in 1986.

Research on a limited number of species has yielded promising results. Dr. Gording noted that Israel has had economic success in producing marketable seafood exports through mariculture, but so far this activity has been confined to specialty seafood items which are exported. Concerning the potential for mass food production, Dr. Gordin said that the laboratory research had demonstrated great promise:

> The ability and potential of marine organisms to grow under farming conditions is amazing. Algae has been shown to grow at a rate of 15 to 20 grams of dry matter per square meter per day. In comparison, we can talk about rice or sorghum or sugar cane which are known to be very productive plants and reach this goal at the same rate.[48]

Limitations to the use of mariculture include the need for further research at a very sophisticated level to determine how to domesticate various fish and other organisms; dealing with the pollution arising from the byproducts of large-scale production operations; and the need to deal with competing uses of shorelines around the world. Mariculture technology has been developed for near-shore and continental shelf applications, but has not yet been adapted to meet the rigors of deep sea, open ocean conditions. Therefore, mariculture practice would depend on available offshore areas that were not in use for other incompatible purposes.

Further, successful mariculture depends upon a clean marine environment at the outset. A problem not directly addressed at

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[47]Hearing at p. 40.

[48]Hearing at p. 41.

the hearing was whether the increasing pollution of the world's oceans would be an obstacle to future mariculture production.

The level of technical expertise required to successfully adapt ocean species to domestic production is high, Dr. Gordin indicated:

> When a fish species is chosen as a candidate for culturing, for example, its basic biology must be thoroughly studied, thus well understood to the level in which farming manipulation can be applied....Reproduction control, larval rearing, nutritional requirements, disease control and grow-out techniques, to mention just a few of the scientific fields that must participate in the R and D process.[49]

Dr. Gordin expressed great confidence that less developed countries with extensive shorelines, especially desert countries where water poses a serious constraint to land-based agriculture, would find mariculture a suitable alternative for food production. However, his acknowledgment of the serious pollution problems to be overcome and the scientific sophistication of mariculture techniques needed to solve them, raises challenging questions: how soon these techniques will be feasible in low-income countries with poor scientific infrastructure and low levels of education, and hence, an absence of a well-trained workforce.

2. Biotechnology

Testimony of several witnesses addressed the potential of biotechnology to increase food production. Biotechnology will facilitate crop plant improvement in much the same way that conventional plant breeding has, that is by conferring desirable traits such as disease-resistance or drought-resistance on agriculturally important plants. The difference between the two techniques lies in the fact that modern biotechnology techniques permit a much more precise transfer of genetic potential, and generally can be accomplished in a much shorter time period.

Dr. Luther Val Giddings, who has worked for the World Bank as well as the Office of Technology Assessment in the area of biotechnology, stated:

> No person familiar with these issues, familiar with the tools of biotechnology or agricultural science doubts that there are substantial advances to be made in applying the tools of biotechnology to agricultural science. ...[A]lthough there is

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[49]Hearing at p. 41.

> enormous potential here in the application of the tools of biotechnology to agricultural production, there are also some very real constraints. In addition to the political constraints and economic constraints you have already heard about, there are some scientific constraints that will in fact limit what this new technology can provide.[50]

The potential for improving agricultural yields through increasing disease and pest resistance might be up to 50 percent for some crops in cases where yields are heavily compromised by these problems. This would not be increasing yields so much as avoiding decreases caused by outside forces; it would be, as Dr. Chandler stated, stabilizing yields:

> One of the biggest impacts of biotechnology and genetic engineering, or whatever you want to call it in the future, is going to be a stabilization of yields at high levels, because you are cutting out the impact of insect and disease attack, adverse soil conditions, etc....another `shot in the arm' [for the green revolution], although I doubt that it will double yields.[51]

Dr. Giddings concluded that the enormous production increases associated with prior revolutions in agricultural technology are not as likely to be associated with biotechnology:

> [I]t is perhaps not realistic to expect the same kinds of quantitative improvements in agricultural productivity that we have seen in the past 40 years .... [where] we have averaged an increase in agricultural production of about 2.4 percent [per year] .... [T]his has begun to level off in recent years. It is by no means clear that biotechnology will enable us to return to those historical levels, much less exceed them -- although in some cases this could be achieved, but on average, that is a much different game. So there are certainly some limitations.[52]

Dr. Giddings also noted the likelihood that biotechnology could be used to reduce environmental problems associated with current agricultural practices:

> I am also quite optimistic about the potential for

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[50]Hearing at p 125 and p. 127.

[51]Hearing at p 126-127.

[52]Hearing at p. 128.

> biotechnological solutions to be environmentally more benign than some of the methods we have used in the past -- particularly those agricultural production schemes that require large inputs [such as chemical fertilizers, herbicides, and pesticides] [53]

Despite his optimism, Dr. Giddings also indicated that the very extensive multidisciplinary research needed to produce advances in biotechnology has been underfunded.

> [A]reas such as fundamental plant science, plant physiology and biochemistry, microbial ecology, systems ecology, evolutionary genetics, taxonomy and systematics, all of these areas have been relatively quite underfunded in the past couple of decades, and all of these areas will be vital to enabling genetic engineers and biologists working in these areas to take full advantage of the opportunities that these technologies will afford.[54]

Maurice Strong testified that he saw promise in biotechnology applications, but warned that development of these technologies could exacerbate existing dislocations between the industrialized countries where food surpluses are produced and the developing countries where the demand for food is growing most rapidly. This is because the need for capital, research, energy and other factors necessary to pursue biotechnology are more readily available in the developed world.

> This situation [imbalances in location of food production] is likely to be exacerbated in the future as new genetic technologies promise major additional increases in production. But again, this is likely to be concentrated -- if we continue on our present pathways -- in the same developed countries that now have food surpluses, and which are the principal sources of these technologies and have the capacities to apply them.[55]

3. Increased Production on Marginal Lands

Large numbers of people in developing countries are dependent upon the farming of fragile, infertile soils for their subsistence. Many of these lands are on steep slopes, subject

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[53]Hearing at p. 128-129.

[54]Hearing at p. 129-130.

[55]Hearing at p. 318.

to erosion; some of these sites were converted from tropical forests, and the inherent poor quality of soil precludes its long-term use for agriculture. This leads to the clearing (by burning) of additional forest in order to allow poverty stricken families one or two additional seasons of crops.

The reasons that farmers have been forced onto such inhospitable lands are many. In some situations, population growth has forced people to leave their original villages and surroundings because there is simply no room for additional people; in other situations, it is land tenure systems that leave them vulnerable to expropriation by wealthy landowners who wish to grow cash crops on the better lands. Whatever the cause, the numbers of people attempting to farm fragile, marginal lands has increased, and in many countries, virtually all the marginal, steep slope lands are in use for meager agriculture. As a result, agricultural centers and private voluntary organizations are increasingly funding research projects aimed at developing techniques to increase the productivity of these lands.

Few figures are available concerning the amounts of food that might be expected from increased tillage of marginal lands; however, testimony at the hearings indicated that it is unlikely that a very sizable proportion of the additional food production needed to supply the world's growing population will come from such lands. Indeed, to the contrary, agricultural and environmental experts argue that farming marginal lands has such dire environmental consequences that they should be taken out of production.

Dr. Pedro Sanchez, Professor and Coordinator, International Program of Tropical Soils at North Carolina State University, reported on results of US-AID sponsored research in the Amazon. This project demonstrated the promise of techniques that can be used on poor soils and by people with limited access to inputs like fertilizer and pesticides. The emphasis of this research is on "sustainable" methods of production that do not degrade the environment. (See further discussion in Section V.) Dr. Sanchez pointed out that the "slash and burn" method of agricultural production used by people who traditionally live in the tropical forest can be sustainable, if practiced with a thorough understanding of the local environmental conditions. This type of farming requires long fallow periods so that areas that were under cultivation are allowed to "rest" and regain fertility. The problems arise when population and economic pressures upset this delicate balance and the traditional agricultural practices are abandoned in favor of shorter fallow periods and less time-consuming practices.

> Shifting cultivation is slash and burn agriculture. The local people know how to do it, but when the new people come in, they do it in disequilibrium ... they don't allow the forests to regenerate for 12 or 15 years .... The question is, can these

> trends be alleviated and eventually reversed [trends that cause continuing migration and deforestation]? And our answer based on long-term research is an emphatic yes, with the use of alternatives to slash and burn.[56]

Dr. Sanchez explained that with relatively low levels of soil inputs such as fertilizers, and rotation of crops, the agriculture yield could be doubled. When the fertility of the soil is too reduced to continue cropping, a fallow season with an appropriate ground cover will eliminate weeds, restore fertility, and retard erosion. Dr. Sanchez's research in this area is currently exploring the next cycle of cropping for its productivity and sustainability. This kind of system can increase productivity for farmers, enabling them to remain in one geographic one area and practice productive agriculture. Such developments could bring a halt to the continual migrations that are responsible for decimating the tropical forests.

V. ENVIRONMENTAL CONSTRAINTS: AGRICULTURAL RESOURCES UNDER STRESS

While the rapidly growing human population creates the need for additional food, the resource base from which that food must be produced is under increasing stress. Testimony at the hearings vividly illustrated the irony that population growth leads to the loss of land and water resources that farmers must use to grow more food to feed the growing population.

At the same time, inappropriate agricultural production methods themselves cause degradation of the land and water resources upon which future production depends. This phenomenon has resulted in the call for "sustainable agricultural development" which is based on the production of food by methods that do not degrade the land and threaten its fertility.

> As the scale of human activities expands, the habitats of other organisms are destroyed directly by paving them over, plowing them under, logging and burning them, dousing them with various toxic substances (including insecticides and herbicides), and so on. Homo sapiens is now causing an extinction epidemic. ...The extinction epidemic, in turn, poses a major threat to humanity's ability to keep increasing agricultural production.[57]

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[56]Hearing at p. 62.

[57]Dr. Paul Ehrlich, letter to Chairman, at p. 7-8.

A. Environmental Problems related to population growth

Witnesses related a wide variety of environmental problems to population growth. Congressman Bill Green observed:

> [H]uman activities at a given per capita level, which might not be very damaging to the ecosystem [when] the world [had] a human population of two billion, may start to be very, very damaging to the ecosystem when the human population is five billion, and even more devastating if the human population reaches 10 billion. You are looking not just at the ozone layer, but issues like loss of tropical forests, desertification. .... [These are] part of a seamless web with this whole issue of how population is stressing our environment and what that means for the whole ecological system of the globe.[58]

Dr. John Stover, Vice-President of the Futures Group, used several examples to demonstrate how increasing numbers of people result in taking land out of agricultural production. Egypt, he pointed out, has a current population of some 50 million, and a growth rate of 2 to 2.5 percent, which means one million people are added every nine months. Only four percent of Egypt's land is arable, and those areas suitable to agriculture (such as the Nite Delta region) are shown to be areas in which the population is concentrated. Using the example of one town of 200,000, Dr. Stover illustrated how the town has spread, eliminating nearly half the surrounding agricultural land. In 1972, the area within a 10 kilometer radius was 90 percent agricultural; by the year 2000, under current trends, the agricultural area will be reduced to 50 percent. In this region as in others, the number of people needing food is growing rapidly while the land to produce the food is being lost at an equally rapid rate.

Dr. Stover also cited the example of Honduras, where a 3 percent population growth rate has produced 3.6 million urban and 4.4 rural people on a land base that is optimally suited to support 2.5 million. This untenable situation results in the uneven distribution of resources, which contributes substantially to political instability in this area.

Dr. Stover estimated recovery times for overstressed natural systems: overgrazed grasslands can recover in a matter of a year or two; fish stocks might take 5 to 10 years; forests recover much more slowly, and could take up to 100 to 150 years to recover.

The key point here is that when population is

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[58]Hearing at p. 4.

> growing at say 3 percent, it doubles in 20 to 22 years. So when populations are doubling every 20 years, it doesn't give these systems time to recover when they are overutilized.[59]

The Honorable Bruce Halliday observed:

> [T]he famine in Ethiopia ... occurred in a country where not too many years ago, 40 percent of that land was covered by forests and trees and now about 4 percent I believe is covered by forests and trees. So that we see, then, how poverty aggravates the whole situation by destroying resources and environment ... And we find that environmental degradation results in terrible human suffering, famine and death.[60]

Patricia Baldi, of the National Audubon Society, pointed out the linkages between resource use and deforestation, climate change, and retention of biological diversity, upon which the development of new food products will depend. She stated strongly a sense of urgency and the need to act expeditiously.

> [W]e have less than a decade to make a substantial difference on these [population] problems, and I get very upset when I sit at meetings with scientists and policy planners, and they talk about 20 or 30 years. If we wait for 20 or 30 years, it is out of our hands. It is in our hands right now. We have a chance to make a difference about population. We have a chance to make a difference about the rate of deforestation. We have a chance to make a difference about a lot of the other issues that we are facing right now. But we have to start now, and we have to do it very quickly and systematically.[61]

Dr. Joyce Starr, Cochairman of the Global Strategy Council, testified that the daily crises produced by overpopulation and poverty reduce the ability of poor countries to plan ahead and deal with some of the longer-term problems that threaten the future well-being of their people.

> [Y]ou are really talking about people that are so stretched creatively, I mean their minds are so taken up with daily crises and problems that they

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[59]Hearing at p. 9.

[60]Hearing at p. 353-354.

[61]Hearing at p. 178.

> don't have the energy to put into trying to restructure the universe they live in. Egypt is going to be 75 million people by the year 2000 [population now is 53 million]. You want to talk to them about all of these issues, and they say, 'Well, we're just mired in trying to get through the day.'[62]

1. Greenhouse effect/climate change

A major international environmental issue that has significant implications for agriculture is the prospect of global climate change linked to the accumulation of "greenhouse" gases in the atmosphere. This change in the earth's atmosphere is the result of increased emissions from human activity of a range of gases such as carbon dioxide, methane, and chlorofluorocarbons (CFCs). While the CFCs in the atmosphere derive entirely from industrial, energy and transport processes, as does the majority of carbon dioxide, both carbon dioxide and methane are also the product of some agricultural and forest processes.

Frances Spivy-Weber, Director of the International Program of the National Audubon Society noted:

> For climate change, ... I think most of the responsibility actually falls in the developed world, and that is something that we, domestically, can do to improve things worldwide. We make up only 21 percent of the world's population, the developed countries, yet we consume 85 percent of the world's energy.[63]

The major sources of carbon dioxide emissions in developing countries are urban transportation (which is greatly exacerbated by population growth) and the burning of forests, usually to clear marginal land for agriculture. Methane is increasing rapidly in the atmosphere, and research is underway to determine the major sources. It is thought that the increasing level of atmospheric methane can be attributed in part to significant increases in numbers of cattle, termite activity, and increases in areas devoted to paddy rice.

In the main, agriculture is not regarded as a primary cause of the greenhouse effect and related climate change. Of most concern to witnesses were the likely adverse impacts of climate change on agricultural production. The possibilities of decreased productivity in the current "breadbasket" areas such as North America and the increased volatility and unpredictability of the

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[62]Hearing at p. 214.

[63]Hearing at p. 193.

weather associated with climate change were of greatest concern. These prospects cast doubts on many of those predictions that are optimistic, and on expectations that the current system is likely to be able to support rapidly increasing populations.

John Stover indicated the importance of climate change as it might affect future food supply, while saying that a longer-term issue of this nature has no place on the agendas of developing countries that are struggling to feed their people today. In this sense, the urgency of the food-population problem in many countries makes any focus on long term problems difficult:

> If you look at the long-term ability of us to feed ourselves, these are by far the most crucial aspects, and we don't know enough about them yet to know just how they are going to affect our ability to feed ourselves. [B]ut because they will be possibly changing the climate of the earth, it's no question that they are going to play the major influence .... However, within an individual country context, we are not likely to see much concern for these kinds of global issues.[64]

Lester Brown drew the comparision between the recent droughts and the concomitant need to draw down the world grain reserves with the possibility that effects of global warming may already be observable. He noted that at the very least, global warming makes food reserve planning an even more urgent priority:

> We do know we have had three severe droughts in this country since 1980... and all three have occurred during one of the five warmest years for the world as a whole....If we are on the edge of a warming, then food security becomes a much more important issue, and the level of prudent reserves ... becomes much higher.[65]

Charles Benbrook related climate change to greater volatility and severity of weather conditions.

> ...[O]ne of the predicted outcomes of global warming is not just warmer average temperatures, but more erratic frequencies of major rainstorms. So we are going to have more severe storms, and fewer nice gentle rains. Severe storms are the major cause of severe run-off, erosion and flooding. If it comes to pass, as in Bangladesh

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[64] Hearing at p. 17.

[65] Hearing at p. 220.

> this past year, that some of the fertile producing regions of the world have 30 percent of the farmland with growing crops flooded out and a season lost, basically, this is going to be, I think, a major factor in the food security equation.[66]

Dr. Paul Ehrlich, Director of the Center for Conservation Biology at Stanford University related both the cause and effects of climate change to population growth:

> Indeed, there is every reason to believe that global environmental problems, worsening at an ever-accelerating pace in part because of human population growth, will be very damaging to agriculture. The most serious of these problems is climatic change, triggered primarily by the rising injections of greenhouse gases into the atmosphere. To a large degree, this problem is generated by the rich nations, which are responsible for about 80 percent of the increase in CO2 from burning fossil fuels. The contributions of poor nations, both from using fossil fuels and from forest destruction and burning, are not negligible, however, and are increasing rapidly as their populations expand. Indeed, rising concentrations of greenhouse gases from both causes are tightly tied to population growth. The climate change and coastal flooding being induced by the greenhouse gases in turn will make it more difficult to feed our burgeoning population in the 21st century.
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> There is no certainty about the exact pattern of climate change that is coming ... but what seems virtually certain is that there will be climatic change, and that it will be rapid. Farmers will have difficulty keeping production up. ...Several problems lie ahead besides that of overcoming social inertia. One is the difficulty of quickly developing new strains of crops to meet altered conditions. More seriously, at least some places where weather is improved for agriculture will not possess suitable soils for the enterprise.[67]

Dr. Ehrlich further noted that there are interrelated effects with negative impacts on agriculture from other environmental problems -- notably, acid rain, with its adverse

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[66]Hearing at p. 312.

[67]Letter to the Chairman, February 28, 1989 at p. 4-5.

effects on vegetation, and ozone depletion from CFCs which will increase the ultraviolet radiation reaching vegetation, changing or damaging many plants' reproductive and photosynthetic mechanisms.

2. Problems due to unsustainable production methods

Agricultural production techniques themselves are often cited as the cause of environmental degradation. Deterioration of the environment causes negative feedback for agriculture itself. Testimony in the Subcommittee's hearings brought out many examples in which "unsustainable" agricultural methods were reducing the future productive capacity of the land. As Maurice Strong stated:

> There is no question that much food production in our countries and in the developing world has been based on practices which are simply not sustainable, ecologically, and in some cases, economically.[68]

Witnesses referred to serious environmental problems caused by agricultural production processes in both food surplus and food deficit countries:

> [T]he world's farmers were beginning to have trouble in the early '70s in keeping up with the 3 percent rate of growth in world food demand that began after World War II. That difficulty first came into focus after the Soviet wheat purchase in 1972. World prices doubled within the next year -- world prices of grain. Farmers around the world, and governments, responded to those price increases by plowing a lot of land that never should have been plowed--land that would not sustain cultivation. There was a lot of investment in irrigation and a lot of investment in irrigation pumps on a scale that could not be sustained, leading to overpumping. The combination of overplowing and overpumping led to this build-up in surpluses. These were not real surpluses, but those produced by borrowing from the future, in effect.[69]

Lester Brown referred to land in several major food producing countries that is being retired from production or abandoned as a direct result of environmental problems which render it unusable for agriculture: 40 million acres of highly

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[68]Hearing at p. 319 (Maurice Strong).

[69]Hearing at p. 217 (Lester Brown).

erodible land (some 11 percent of total United States cropland) is being put into conservation reserves and converted to grassland or woodland; some 13 percent of cropland in the Soviet Union has been abandoned since 1977 due to the erosion of topsoil; and since 1978 in China, 7 percent of cropland has been lost, as a result mainly of conversion to nonfarm, industrial uses.

Environmental problems in Europe are also severe, in many ways pointing up the resource deterioration attendant upon highly intensive production methods, according to Charles Benbrook:

> I think the European continent has much more severe and serious environmental problems facing its agriculture, largely because of the very high internal prices. Farmers in Europe are using much more intensive methods, much more high cost production practices than currently in much of the United States. And as a result, the environmental problems that are emerging in Europe really make ours pale by comparison.[70]

Although the technologies underlying the "green revolution" have greatly increased yields of staple food crops in many Asian countries, and were developed for use on fertile lands, these methods have had an adverse impact on the environment. Extensive irrigation was part of the technology package in many areas, and it is estimated that in the expansion of irrigation into new areas, as much land is lost each year to salinization and waterlogging due to poor design as is gained through new irrigation. Charles Benbrook acknowledged some "serious economic and environmental consequences in some areas", although he expressed the belief that, on balance, little land was irreparably lost.[71]

Similarly, Ronald Trostle stated that despite environmental degradation from improper application of some of the "green revolution" technology, the net gain in food production was on good lands where degradation was not such a problem. With regard to environmental impacts even on good lands, he stated:

> There are a few deleterious indirect effects, however. Occasionally, poor control of irrigation water in delta areas has led to salinization of soils. Also, improper use of fertilizers and pesticides may have caused some contamination of ground water.[72]

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[70]Hearing at p. 306.

[71]Hearing at p. 475.

The testimony of Dr. Wangari Maathai, founder of the Greenbelt Movement in Nairobi, Kenya, expressed concern that high technology solutions offered in assistance programs in Africa cost too much -- both in terms of money, and in terms of environmental degradation.

> To increase their crop yields, farmers need to improve the fertility, or regenerative capacity of their soil with simple and inexpensive methods available to them [such as animal manures, agroforestry, composting, etc.] The practice of planting, for example, nitrogen-fixing trees with crops enhances soil fertility, retains soil moisture, and reduces erosion; hence, crop yields increase. Chemical fertilizers, pesticides, new seed varieties and huge irrigation schemes are some of the solutions being offered to African farmers. These solutions will not work. They won't work because: fertilizers and pesticides cost too much in foreign currency to be sustained....they do not promote the regenerative capacity of the soil, that is, sustainable farming. So they don't offer any long-term solution.[73]

This concern was echoed by Charles Benbrook:

> Attempts to increase production in developing countries through importation of developed world chemical and capital-intensive technologies are likely to fail on economic and technological grounds. Moreover, these technologies can add dangerous new dimensions to natural resource degradation, and set the stage for a new generation of environmental problems, including water pollution, wildlife poisonings, and human death and disease. (Emphasis added)[74]

Moreover, Dr. Benbrook described serious problems in resource degradation that reduces productive capacities:

> Many developing nations face an almost impossible task in even slowing down current alarming rates of erosion in the productive capacity of natural resources. Erosion, desertification, water-logging, salinity, and the loss of species will be very difficult to reverse in countries facing the twin

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[72]Hearing at p. 471.

[73]Hearing at p. 454-455.

[74]Hearing at p. 301.

plagues of population growth and poverty.[75]

Problems in achieving sustainable food production and in minimizing the degradation of environmental resources are related directly to the increasing pressures on all types of land. As small subsistence farmers are displaced from good lands by population growth or industrial, cash crop operators, they turn in desperation to steep slopes or tropical forests. Without detailed knowledge of these lands that long-time residents might have, the farmers use unsustainable methods of production that give poor yields and, worse, cause heavy soil erosions and further lack of productivity. As Raymond Hopkins testified:

> One consequence of this population growth is increased demand for food and growing pressure on arable land, increasingly land of marginal value for production, to secure additional food. Agronomic practices which in earlier periods were ecologically stable have been altered as agriculture has intensified the use of land and moved into these marginal lands. Consequently, the rate of deforestation in countries ranging from Brazil and the Ivory Coast to Ethiopia and Nepal are large and rising.[76]

Lester Brown noted:

> [I]f you want a really simple model of the world food economy you can look at in both demand and supply terms: the world's farmers each year are now trying to feed 86 million more people, and they are trying to do it with 24 billion fewer tons of topsoil each year. That is the net loss in erosion that we estimate. That is about the amount of topsoil on Australia's wheatland.[77]

3. Water Scarcity as a Constraint to Food Production

Water scarcity is a problem of escalating proportions in many areas of the world. Experts testified that the problems facing Middle East countries are already at crisis levels. Agriculture is the largest consumer of water in most countries, but other economic sectors are rapidly expanding and creating greater competition for water.

Dr. Joyce Starr, of the Global Strategy Council, stated:

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[75]Hearing at p. 301.

[76]Hearing at p. 265.

[77]Hearing at p. 221.

> [T]he world does not have enough water for the population that we have today. [N]ot enough water to drink, not enough water for agriculture, not enough water for industry. The world is going to need, by the year 2000, $180 billion to invest. We know that the CIA has targeted approximately ten spots in the world where war could break out over water. ... Water is a conflict issue. We may bring the Israelis and the Jordanians and the West Bankers and the Gazans and even the Syrians to a peace process. It may begin, and it may completely break down over the issue of water.[78]

John Stover cited Jordan as an illustration of environmental constraints on agricultural development saying that the growth levels in urbanization and industrialization that will create enormous new demands on the available water.

> Today only about 20 percent or so of water is required for municipal and industrial demand. But given the high rate of population growth of about 4 percent, and efforts to increase the consumption per capita,... by the year 2010, even with a doubling of water available, some 50 percent of all this water would be required for municipal and industrial purposes. ...[T]he amounts left over for agriculture would be no higher in the year 2010 than it is today, even if water supplies could be doubled. What this means, of course, is the amount of irrigated land, even with new technologies, will not be able to increase very much. And Jordan will experience increasingly larger and larger deficits in its balance of agricultural trade.[79]

Dr. Starr deplored the lack of a long-term plan both within the United States and internationally to deal with water problems. She indicated a number of technological breakthroughs that could be pursued, but saw little of the required leadership necessary to do so.

> We will never increase the amount of water that we have. ... [T]here won't be more water, but we can deal with the water levels that we have. We can clear up the water; we can clean the water, and with desalinization ... breakthroughs we may even be able to use seawater on a general basis, which we can't do today, because it is far too expensive.

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[78]Hearing at p. 151 (Lester Brown).

[79]Hearing at p. 8-9.

> I believe there are many things that our government can do but first and foremost we can take a leadership role, which we have not done.[80]

4. Debt as a Resource Constraint: Impacts on environment and food production

The negative influence of international debt on environment, resources, food production, population growth and human welfare was a recurrent theme in the Subcommittee's hearings. Concerning improvements in social welfare necessary to bring about the demographic transition to lower birth rates and thus lower total population growth, several witnesses emphasized that debt pressure was central to the reductions many countries have been making in the area of health, education and other human resource investments.

Subcommittee Chairman James H. Scheuer noted the UNICEF report that found an increase of some 500,000 deaths of women in childbirth worldwide due to cutbacks in health care, and an increase of some 15 million children afflicted with malnutrition, also due to social welfare cutbacks related to economic pressures on developing coutnries to service interest and amortization to repay international debt.[81] The Honorable Bruce Halliday of Canada noted that some 25 percent of developing countries' revenue goes to pay debt interest and principal, resulting in drastic reductions in human services.[82]

It is clear that pressure for exports in order to obtain the foreign exchange currency needed for debt repayment has influenced agricultural policies, encouraging cash crop operations at the expense of subsistence agriculture by forcing subsistence farmers onto marginal lands. The impact of debt on village-level activities which detract from the ability of poor people to support themselves were noted by Waafus Ofosu-Amaah. She indicated that in terms of livestock raising activities, the priority for governments was for large-scale cattle ranching for export, in order to obtain foreign exchange to pay the debts. Women farmers in Africa indicated that the enormous pressures of debt on their countries created conflicts between environmentally-sustainable practices and the need to export agricultural commodities which stressed the land.[83]

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[80] Hearing at p. 153.

[81] State of the World's Children Report 1989, UNICEF

[82] Hearing at p. 351.

[83] Hearing at p. 216.

VI. WITNESS RECOMMENDATIONS

The following recommendations for actions were made by witnesses throughout the course of the hearings.

A. AGRICULTURAL DEVELOPMENT

Increasing demand for food is urgently associated with rapid population growth, and there are difficulties in meeting the current world food needs. A major effort to address these concerns is required on the part of both developed and developing countries.

1) **A substantial, internationally-based program of agricultural research should be undertaken augmenting existing research efforts and focusing on innovative technologies.**

   -- Emphasis should be placed on the development of new crops that can adapt to harsh environmental conditions;

   -- Research on more efficient and resource conserving methods of food production on marginal lands is critical;

   -- New types of food production, such as mariculture, should be explored, as an option for providing high quality dietary protein in coastal countries experiencing problems in land-based agricultural production;

   -- Biotechnology research should receive greater funding, in order to take full advantage of the opportunities it may afford;

   -- Flexible agricultural systems that are more resilient in the face of harsh environments should be emphasized.

2) Environmentally sustainable agriculture must be a high priority in order to avoid the "mining" of fragile soils and the loss of soil through erosion. Multidisciplinary efforts are necessary to achieve this goal, not only in research, which is critically important, but also in extension and practical applications.

3) Food aid will continue to be important to food deficit countries. Such aid should be carefully designed and targeted to avoid negative impacts on local agricultural production. However, it should also be used in carefully thought out programs of food-for-work that can maximize its effectiveness both in feeding people and helping them meet development goals.

B. POPULATION GROWTH

The world is facing rates of population growth in many regions that are a threat to the well-being of those countries and entail severe environmental pressures and potential food shortfalls. Policies to moderate these growth rates are urgently needed, and should be supported at every opportunity.

1) National and international policy should recognize the importance of population growth as it may affect economic development, environmental protection, per capita food consumption, and other critical needs. Policies in these areas should factor this population growth into plans for present and future development.

2) High priority and increased attention must be accorded to family planning policies and programs.[84] Assistance from the developed countries should support family planning programs in developing countries and should provide up-to-date information to policymakers on population growth and family planning options.

   - Multilateral population organizations should be supported and funded;

   - Bilateral family planning assistance should have a high priority in the United States foreign assistance program;

   - Recruitment of local and national population officers in all high-growth countries should be encouraged by U.S. policies;

   - Support should be continued for data collection and research on the causes and consequences of rapid population growth, focusing activities on operational policies and building developing country capacity to conduct population programs.

3) A commission on population growth and natural resource use should be formed at the national level in each developing country, with a capacity for long-range analysis and planning. Links to similar commissions in other countries and at the regional and international level should be sought.

C. SOCIAL AND ECONOMIC DEVELOPMENT

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[84] These recommendations address programs to prevent or avoid conception, not to terminate pregnancies. Witnesses at the hearings did not discuss the issue of abortion, and the witness' recommendations take no position on abortion matters.

Social and economic development are threatened by the rapid rates of population growth the world is facing. Development of human resources is the key to ameliorating both population growth and negative economic consequences.

1) Economic development must emphasize human resource development if the demographic transition to lower population growth rates is to occur. Economic development programs, both bilateral and multilateral, should emphasize education and public health.

2) The critical role of women must be recognized and supported in all economic and human resource development efforts. This is essential if population growth rates are to be reduced. It is also essential for effective agricultural development in the many developing countries where women perform the majority of such work.

   The key to such development is to increase education and job training for women in order to provide them with access tp jobs and increased economic status. Improving women's economic and social status in developing nations is the keystone effort that supports economic development, increased agricultural productivity, conservation of natural resources, and a reduction in birth rates.

   Although public policies are beginning to be more supportive of women's roles and the need for emphasis on increasing women's opportunities, it is rare that these policies are effectively put into practice. Greater focus on and support for the status of women are required to yield any progress in agricultural development, environmental protection, rural development, and education to benefit all people.

D. ENVIRONMENTAL AND NATURAL RESOURCE PROTECTION

An increasing number of environmental problems are being recognized as threats to agricultural production and human well-being. Measures to avoid natural resource degradation are particularly important in the face of the rapidly increasing need for food for growing populations. The resource base from which this food is to be produced must be protected from degradation. In addition, it is essential that food production systems be made resistant to major environmental threats such as global climate change.

1) Protection of fragile, marginal lands is of critical importance. These lands are often farmed in ways that reduce or eliminate their ability to support agriculture. Agricultural development programs should be designed to prevent soil erosion, and desertification and to avoid the improper use of chemical additives

(pesticides or fertilizers) that may have long-term negative impacts on soil or water;

2) Greater rural and urban development planning is necessary to minimize the loss of valuable agricultural land to uncontrolled urbanization;

3) Shortages of water already constrain agriculture in many geographic areas. Water conservation and planning should be a critical priority for all uses -- agricultural, industrial and municipal.;

4) Both nationally and internationally a high priority must be given to monitoring and coordinating information on:

-- Food production
-- Water resource availability
-- Water quality
-- Soil erosion

These and other critical indicators of environmental well-being underlie all other considerations.

E. DEBT ALLEVIATION

The heavy debt burden carried by many developing countries constitutes a severe constraint on development. Areas such as human resource development, environmental protection, natural resource management, and basic food production are all threatened by the shortage of financial resources in many countries due to the pressures they face to obtain foreign currency to repay international debt.

1) Debt reduction should be a high priority for developed and developing countries.

2) Debt-for-nature swaps and other methods of trading debt for important development and conservation goals in these countries should be supported by U.S. policy, and sought through international cooperation.

THE GLOBAL FOOD AND POPULATION EQUATION: A FRAGILE BALANCE
ADDITIONAL VIEWS

During the hearings of the Subcommittee on Natural Resources, Agriculture Research and the Environment on this issue, there was an important discussion on the role of market economies and the role that governments can play in determining whether countries will progress towards development or remain dependent on foreign assistance. It was pointed out that some governments have systematically pursued policies which are antithetical to the development of market economies, and have even engaged in tactics which result in the starvation of entire populations. It is important to recognize that only when these fundamental policies are changed can developing nations begin to feed their people.

Another topic of discussion during the hearings was population growth. We want to make clear that the Committee does not support the use of abortion as a means of population control. While family planning programs aimed at avoiding conception should be supported, advocacy of abortion as a population control technique should continue to be opposed by the U.S. government.

In addition to footnotes added to the report on these two issues, we wish to reiterate that the witness recommendations on population growth and food supply do not reflect the views of some Committee Members.

ROBERT S. WALKER
DON RITTER
ROBERT C. SMITH
RON PACKARD
JAMES F. SENSENBRENNER, JR.
PAUL B. HENRY
DANA ROHRABACHER

APPENDIX

WITNESSES FOR FOOD AND POPULATION HEARINGS

February 23, 1989

Dr. John Stover, Vice President, The Futures Group
Dr. Robert Chandler, World Food Prize Winner
Dr. Hillel Gordin, Director, National Center for Mariculture, Eilat, Israel, Oceanographic and Limnological Research Institute
Dr. Pedro Sanchez, North Carolina State University
Dr. Ronald Trostle, Chief, Commodity and Trade Analysis Branch, U. S. Department of Agriculture
Dr. Luther Val Giddings, Biotechnology Consultant, The World Bank
Dr. Joyce R. Starr, Co-chairman, U. S. Global Strategy Council
Ms. Patricia Baldi, Director, Population Programs, The National Audubon Society
Ms. Frances Spivy-Weber, Director, International Program, The National Audubon Society
Dr. Waafus Ofusu-Amaah, Founding Member of Worldwide
Mr. Lester R. Brown, President, The Worldwatch Institute
Dr. Raymond F. Hopkins, Chairman, Department of Political Science, Swarthmore College
Dr. Charles Benbrook, Executive Director, Board on Agriculture, National Research Council
Mr. Maurice Strong, Chairman, American Water Development, Inc.

March 2, 1989

Hon. Sat Pau Mittal, Parliamentarian, India
Hon. Bruce Halliday, Member of Parliament, House of Commons, Canada
Hon. David J. Kwidini, Minister of Youth, Sports and Culture, Zimbabwe
Hon. Celso Sotomarino, Senator, Peru
Hon. Robert Key, Member of Parliament, House of Commons, England
Dr. Fred Sai, Senior Population Advisor, World Bank
Prof. Wangari Maathai, Coordinator, Green Belt Movement, Kenya
Dr. Carl Wahren, Head, Aid Management Division, Organization for Economic Cooperation and Development

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